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New Species and Populations of *Lysiphlebus* Foerster-Aphid Parasitoids (Hymenoptera: Braconidae: Aphidiinae) in Korea

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Abstract An analysis of *Lysiphlebus* Foerster species reared from various field-collected aphid species determined the presence of probably trans-palearctic *L. fabarum* (Marsh.), *L. testaceipes* (Cress.) which is an accidentally introduced and established immigrant from North America, and *L. koraiensis* Starý sp. n., a native species of presumably broader distribution. Both parthenogenetic and biparental populations of *L. fabarum* were identified in Korea.

Key words Taxonomy, parthenogenesis

INTRODUCTION

Research on aphid parasitoids has been found to represent a rather fruitful result, contributing positively to an over-all information from taxonomical and faunal research to the biodiversity studies and biological control both in the target area, the Korean peninsula, and in the abroad (see: Starý and Choi, 2000).

The present account centers the aphid parasitoids of the genus *Lysiphlebus* Foerster in Korea. A background information on the target genus was presented within the framework of a general study on the subfamily in Korea (Starý and Choi, 2000).

MATERIALS AND METHODS

Evidence on the *Lysiphlebus*-species was primarily derived from the broader studies on aphids and their parasitoids in Korea (see: Acknowledgements).

The material was obtained from field-collected aphid colonies targeting the determination of tritrophic associations of parasitoids in various ecosystems in Korea.

Material was sampled both in North (1985, 1987, 1988) and in South (1999) Korea by J. Havelka. The numbers of the samples correspond to the database of aphids of Korea utilized by J. Havelka. Aphid identification was done by J. Holman and J. Havelka, and parasitoids identification by P. Starý.

The sampled material was deposited in the collection of P. Starý (Č. Budějovice) and in the Entomology Division of NIAST (Suwon).

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The morphological nomenclature utilized in the description of a new species followed Sharkey and Wharton (1997), except where otherwise stated and explained in the figures.

Abbreviations: F–Female, M–Male, NK–North Korea, SK–South Korea.

REVIEW OF SPECIES

The information on the individual species includes the following evidence: Aphid species, locality, administrative district or a broader area (in brackets), date, host plant, number of specimens including sex information, sample number (in brackets).

Lysiphlebus fabarum (Marshall)

Specimens examined, emerged from:

Acyrthosiphon kondoi Shinji: NK, Pyongyang-si Bot. garden (Pyongyang-si), 4 VI 1988, *Psolaria coryfolia*, 7F, 1M (88HA2891).

Aphis craccivora Koch: NK, Taesong-san Bot. garden (Pyongyang-si), 3 VI 1988, *Astragalus sinensis*, 88F (88HA2874); NK, Wonsan Bot. garden (Mt. Kumgang-san), 28 V 1988, *Kochia scoparia*, 22F (88HA2645).

Aphis spp.: NK, Taesong-san Bot. garden (Pyongyang-si), 3 VI 1988, *Matricaria chamomilla*, 2F (88HA2869); Ditto, 2 VI 1988, *Pyrethrum leptophyllum*, 3F (88HA2879).

Myzus mumecola (Mats.): NK, Taesong-san Bot. garden (Pyongyang-si), 30 V 1988, *Prunus ansu*, 1F (88HA3475).

Lysiphlebus koraiensis Starý sp. n.

Diagnosis. The new species is easily distinguished from the other Korean species by forewing venation and pubescence: The long and prolongately triangular stigma and long metacarp relate this species to *L. fabarum*. The lower marginal setae are short and equal in length to the surface setae in the latter species. (The combination of the long marginal setae on the forewing and the adpressed setae on the hind femora and tibiae distinguish the new species from its possible Oriental (*L. delhiensis* Sharma and Subba Rao) and European relatives).

Etymology. The name of the new species is derived from its known distribution area, the Korean peninsula.

Female. Head–Eye length 2.5 times as long as malar space. Intertentorial line 1/4–1/5 longer than tentorio-ocular line. Maxillary palpi 3-segmented, labial palpi 1-segmented (Fig. 14). Antenna 12 (rarely indicated 13)-segmented, slightly thickened to the apex. First flagellar segment (= Fl 1) 2.5 times as long as broad, Fl 2 subequal to Fl 1 (Fig. 17). Fl 1–4 with adpressed setae. Longitudinal placodes: Fl 1 (0–1), Fl 2 (0–1), Fl 3 (2–5), Fl 4 (4–6).

Mesonotum with notauli distinct in the ascendant portion, effaced but traced by a simple row of setae on the disc. Propodeum (Fig. 12) smooth, with sparse setae in the lateral corners. Forewing (Fig. 11): Stigma prolongately triangular, relatively long and narrow, about 4 times as long as broad. Metacarp long, at least as long as stigma, almost reaching wing apex. Radial abscissa 1 slightly less than twice as long as stigma width. Radial abscissa 2 distinctly longer than abscissa 1. Lower marginal setae about three times as long as the surface setae, the distance between them equal to about 1/3 of their length (Fig. 15). Hind femora and tibiae with adpressed setae (Figs. 13, 16).

Petiole (Fig. 18) broadly triangular, its length equal to apical width. Spiracular tubercles situated at the end of the proximal third, slightly prominent. Smooth, with sparse setae. Genitalia (Fig. 19).

Coloration. Head dark brown. Lower part of clypeus and mandibles except apices yellow.

Palpi light yellowish. Antenna brown, with scape, pedicel and base of Fl 1 yellowish. Mesosoma brown, prothorax and basal part of mesonotum yellow brown. Tegulae yellow. Wing venation brownish. Fore and middle legs prevalently yellow, hind legs yellow brown and their trochanters brown. Metasoma brown, petiole and tergite 2 yellow.

Body length. about 1.5–1.8 mm.

Male. Antenna 13–14 segmented. Forewing marginal setae about three times as long as the surface setae. Coloration similar as in female, but darker.

Materials. Specimens examined, emerged from:

Holotype F, paratypes 28 F and M: *Aphis craccivora* Koch: NK, Moranbong (Pyongyang-si), 21 VI 1987, *Kochia prostrata* (87HA1947).

Aphis spp.: NK, Taesong-san Bot. garden (Pyongyang-si), 2 VI 1988, *Pyrethrum leptophyllum*, 4 F and M (88HA2831); Ditto, 2 VI 1988, *Matricaria chamomilla*, 5 F and M (88HA2869).

? *Cinara piniformosana* (Tak.): NK, Onjong-si (Mt. Kumgang-san), 19 V 1988, *Pinus densiflora*, 1M (88HA2478) (Host record questionable).

Megoura crassicauda Mordv.: NK, Pyongyang-si Bot. garden (Pyongyang-si), 31 V 1988, *Vicia japonica*, 43 F and M (88HA2925).

Holotype female and paratypes in coll. of P. Starý.

Notes. *L. koraiensis* seems to be the species identified formerly as *L. delhiensis* Sharma and Subba Rao in Korea (Starý and Choi, 2000). However, the latter species was described from some parts of India (Starý and Ghosh, 1983; Raychaudhuri, 1990), whereas its broader distribution is not known. Moreover, it belongs to a different species-group (*L. confusus* Tremblay and Eady), which requires a closer taxonomic treatment.

Lysiphlebus testaceipes (Cresson)

Specimens examined, emerged from:

Aphis sp.: NK, Hyesan (Mt. Paektu-san), 11 VII 1987, *Rumex crispus*, 10 F and M (87HA2228).

Rhopalosiphum padi (L.): NK, Hyesan (Mt. Paektu-san), 13 VII 1987, *Prunus nakaii*, 4 F and M (87HA2300).

Key to species (females)

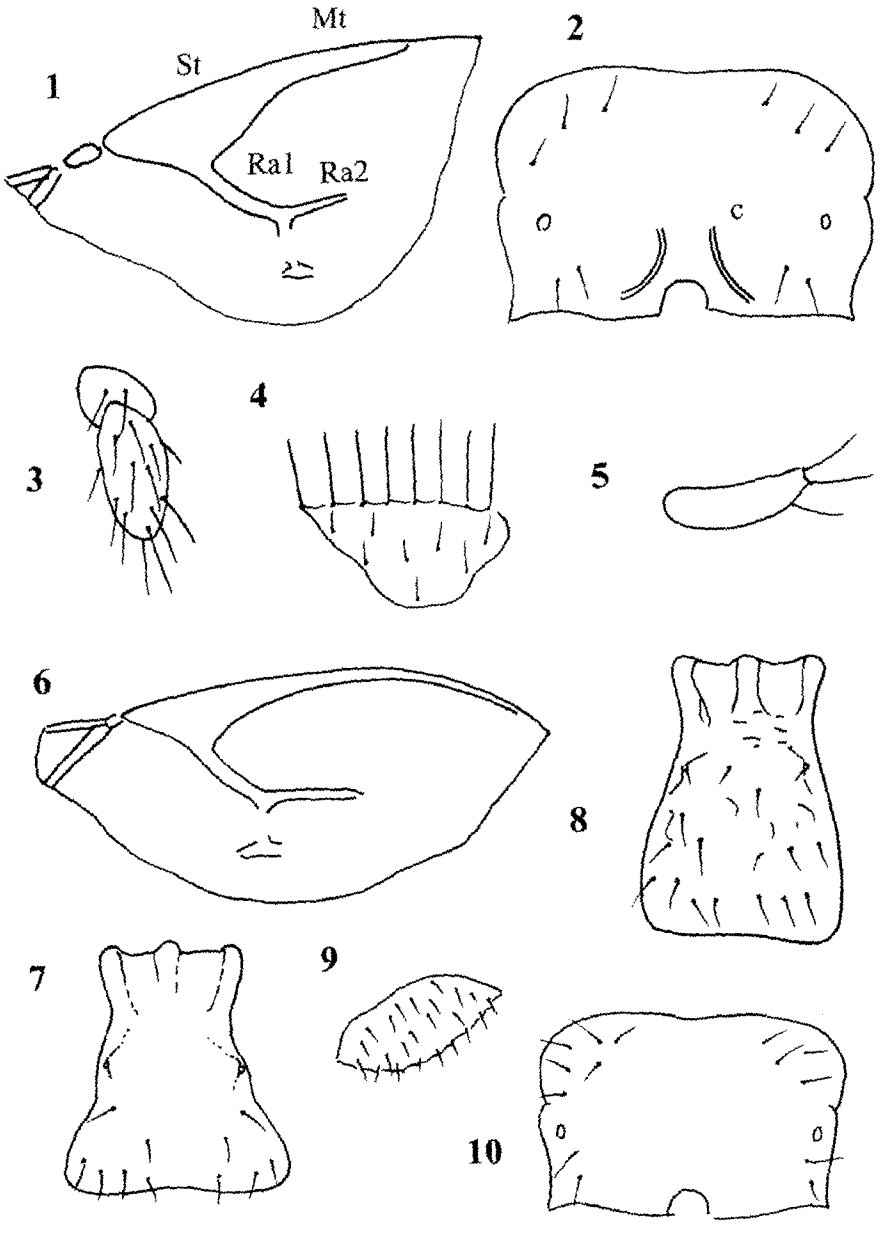
1. Metacarp long and almost reaching wing apex (Figs. 6, 11). Labial palpi 1-segmented (Figs. 5, 14). Propodeum smooth (Figs. 10, 12). Petiole broadly triangular (Figs. 7, 18) 2
– Metacarp short and distinctly not reaching wing apex (Fig. 1). Labial palpi 2-segmented (Fig. 3). Propodeum with short divergent carinae in the distal portion (Fig. 2). Petiole narrowly triangular (Fig. 8) ..... *testaceipes* (Cresson)
2. Forewing lower marginal setae short, equal to the surface setae (Fig. 9) ..... *fabarum* (Marshall)
– Forewing lower marginal setae long, about three times as long as the surface setae (Fig. 15) ..... *koraiensis* Starý sp. n.

Note. The males of all the species manifest forewing lower marginal setae distinctly longer than the surface setae.

POPULATIONS

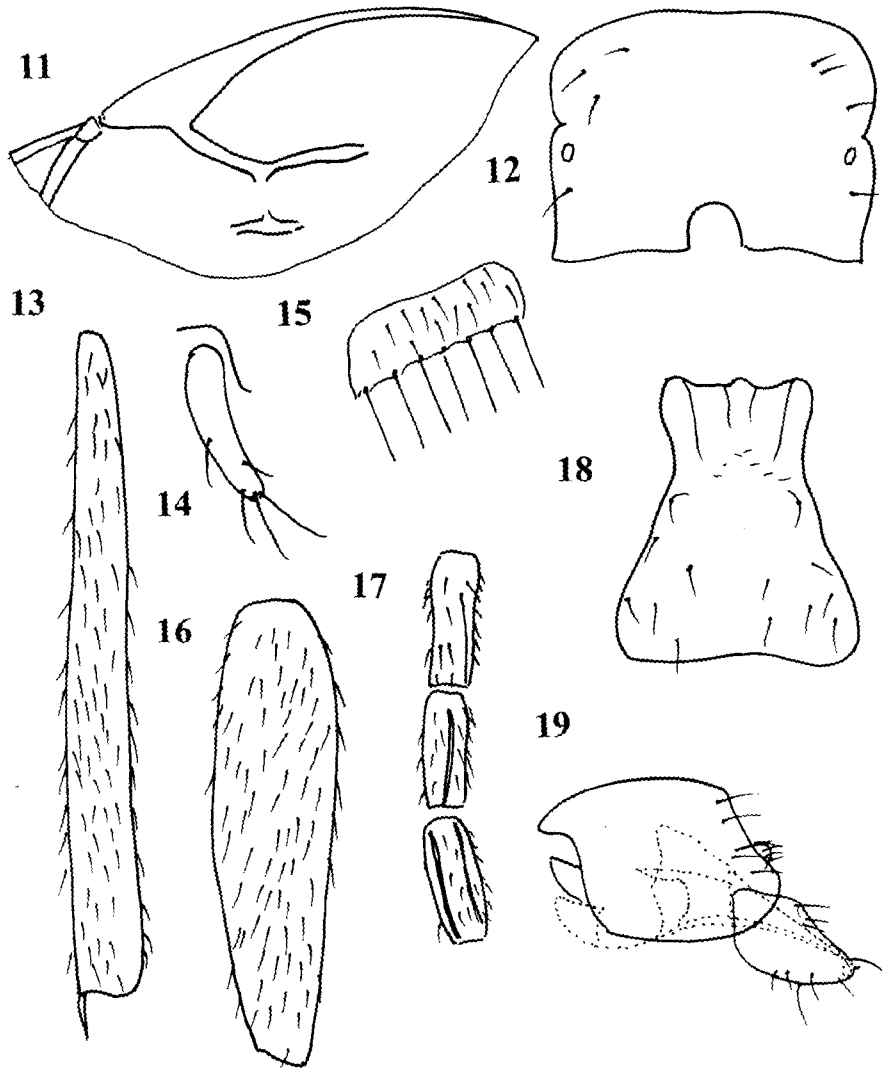
The genus *Lysiphlebus* Foerster is almost a unique group among the aphidiines in which both biparental and uniparental (parthenogenetic-thelytokous) populations were determined.

Parthenogenetic populations were found commonly in *L. fabarum* (Marsh.) and several other species, or species-groups namely in Europe (Starý, 1999; Belshaw *et al.*, 1999, also for



Figs. 1-10. *Lysiphlebus testaceipes* (Cress.): 1-forewing, detail. 2-Propodeum. 3-Labial palpus. 4-forewing lower marginal setae and surface setae. 8-Petiole. *Lysiphlebus fabarum* (Marshall): 5-Labial palpus. 6-Forewing, detail. 7-Petiole. 9-Forewing lower marginal setae and surface setae. 10-Propodeum.

Refcs.), the phenomenon being derived from the association with the microbes or due to genetic peculiarities. The parthenogenetic females are also known to manifest a peculiar behavior in forming clusters or aggregations in the course of oviposition (Génieys, 1926; Starý and Voelkl, 1988).



Figs. 11-19. *Lysiphlebus koraiensis* Starý sp. n. (paratype): 11-Forewing, detail. 12-Propodeum. 13-Hind tibia. 14-Labial palpus. 15-Forewing lower marginal setae and surface setae. 16-Hind femur. 17-Flagellar segments 1-3. 18-Petiole. 19-Genitalia.

An analysis of our original material (see: Review of species) is sufficient to prove the occurrence and even prevalence of parthenogenetic populations, with an indication of the presence of bisexual populations of *L. fabarum* in Korea.

The detection of parthenogenesis in *L. fabarum* in Korea is rather important because of contributing to the target information as known from Europe and the Mediterranean. Also, it is apparent that the parthenogenetic populations have been capable to extend their natural spread from their presumed area of origin (West-Palearctics) to the Far East Asia. Both the West- and East-palearctic evidence represent thus a single group, while contradicting to the situation in North America where solely biparental populations were determined among the native

congeners (see: Pike *et al.*, 2000).

HOST-PARASITOID RELATIONSHIPS

Host aphid \ *Lysiphlebus* sp.	*L. fabarum*	*L. koraiensis*	*L. testaceipes*
Acyrthosiphon kondoi	○		
Aphis craccivora	○	○	
Aphis spp.	○	○	○
Cinara piniformosana (?)		○	
Megoura crassicauda		○	
Myzus mumecola	○		
Rhopalosiphum padi			○

FAUNAL RELATIONSHIPS

The genus *Lysiphlebus* is known to be distributed mainly in the northern hemisphere, with the presumed speciation centers in the West-Palearctics and the Nearctics, and with the distribution ranges of some species penetrating more or less to the south. Our information from Korea supplements this evidence indicated earlier by Starý (1975, Far East) and Takada (1968, Japan) and others (Starý and Choi, 2000, Korea). However, the determination of Korea and adjacent areas as another potential center needs further support: Among the three species determined in the area by our evidence, *L. fabarum* is rather common in the West-Palearctics and its detection in Korea might be a proof of its trans-palearctic distribution, whereas valuably identified material from the areas in between has still been insufficient.

L. testaceipes is doubtlessly a result of an accidental introduction due to the activities by man or/and wind streams: The species belongs to the commonest aphidiine parasitoids, moreover manifesting rather extensive distribution together with a broad host range in North America (Marsh, 1979; Pike *et al.*, 2000). Therefore, its accidental spread as well as establishment in Korea can be presumed to be rather easy and potentially even efficient in supplementing the native parasitoid guilds. An illustrative example can be reported from southern France and the Mediterranean in general where the species has been purposely introduced (for initial reference, Starý *et al.*, 1988). The third species, *L. koraiensis* is most probably a species that manifests a broader distribution in at least the Far East Asian area.

It should be added that the classification of many species of the genus in Europe needs more special taxonomic treatment (cf. Belshaw *et al.*, 1999).

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